ABOVE GROUND STORAGE TANK

GUIDANCE DOCUMENT

Revised 2010

Developed By:

Department of Environmental Protection

Division of Water and Waste Management

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SECTION 1.0

APPLICABILITY

These instructions are applicable to municipal and private industries who presently maintain Above Ground Storage Tanks (AST). This document also provides details for the installation of new ASTs and the decommissioning of old ASTs.

Use of Above Ground Storage Tanks (AST) in West Virginia is regulated by 47CSR58, the Groundwater Protection Rule. Hazardous Waste (DWWM), Mining (DMR), Dept. of Agriculture, and other programs have taken the general requirements developed by the Groundwater Program and adapted them to their specific scenarios. AST owners who are regulated by other programs should ensure they meet the appropriate requirements of those programs.

NOTE: There is no certification program for AST installers in West Virginia.

SECTION 2.0

INTENT OF INSTRUCTIONS

The purpose of these instructions is to provide a guide for the construction, installation, use and maintenance of ASTs using current environmental practices and procedures. Questions concerning this document should be directed to the West Virginia Department of Environmental Protection's Division of Water and Waste Management.

These instructions have been developed as guidance, not a rule. They may be altered to fit facility-specific conditions as needed. The WVDEP has developed this guidance document as an outline of the suggested content to be addressed when considering the installation and use of an AST.

SECTION 3.0

AST REQUIREMENTS

3.1 Secondary Containment

Secondary containment refers to a structure usually constructed of dikes or impervious walls to contain the tank contents in the event it is drained out. Section 4.8.a. of 47CSR58 requires that all ASTs have secondary containment that is appropriate to protect against groundwater contamination. This clause allows DEP to waive the secondary containment requirement for tanks containing a compressed gas such as propane. The secondary containment must be designed and constructed to contain the full contents of the largest tank within the containment unit until the spilled material can be removed without contamination of groundwater.

3.1.1 Secondary Containment Volume

The Groundwater Protection Rule does not specify the volume of secondary containment structures. Logic dictates that the secondary containment be able to hold the entire content of the largest tank within the containment field in case of a catastrophic failure.

3.1.2 Containment Waiver

West Virginia does not have a minimum tank volume below which secondary containment is not required. 47CSR58 section 11 does, however, provide a waiver for some or all of the requirements if the director determines they are not necessary to protect against groundwater contamination. When applying for a waiver from providing secondary containment for a small AST, explain how an alternative practice would be as protective of groundwater as secondary containment. For instance, a tank may be located so that its contents would drain to a waste water treatment facility if the tank were ruptured. Another alternative might be procedures to inspect a small tank hourly and maintaining a spill containment kit at the tank. Alternatives to secondary containment must be approved prior to placing the tank into service. If the waiver is not approved before the tank is placed in service, the tank is out of compliance with 47CSR58, Section 4.8.a.

3.1.3 Impermeable Barrier

ASTs which rest on the ground or are partially buried must have an impermeable barrier under the tank and a leak detection system between the tank and the barrier. The barrier acts as a liner to redirect leaks to a perimeter system where they can be visually observed.

3.2 Groundwater Protection Plan

Any facility using an AST must prepare and implement a Groundwater Protection Plan (GPP) according to 47CSR58. In addition to the mandated requirements of a GPP, all AST facilities should implement good housekeeping practices, operating procedures and spill response procedures.

SECTION 4.0

AST CONSTRUCTION

4.1 Materials & Standards

Above Ground Storage Tanks should be constructed in accordance with a national standard such as Underwriters Laboratory (UL) Standard #142, or one of the two standards developed by the American Petroleum Institute (API), Standard #620 or #650. The majority of ASTs are constructed in accordance with UL 142.

ASTs may be constructed of any material that is appropriate for its contents and is protective of groundwater. For instance, it would be inappropriate to store petroleum in a fiberglass or plastic AST. These tanks are easily punctured and would melt if exposed to fire.

4.2 Corrosion Control & Protection

Corrosion is one of the most prevalent and insidious causes of leaks. Because the large surface area of AST's cannot be easily inspected, leaks that develop tend to go on for long periods with large contamination pools resulting. Corrosion can be mitigated by proper foundation design and material selection, use of lining and coatings for topside and bottom side corrosion, cathodic protection and chemical inhibition. Some of the most common methods of corrosion control and prevention relate to:

- Linings
- Corrosion Allowance
- Design (avoidance of dissimilar metals, galvanic couples, improper materials, high fluid velocities in inappropriate places, caulking or seal welding of areas susceptible to crevice corrosion, roof design, etc.
- Sacrificial anodic systems
- Impressed current cathodic protection
- Use of high-alloy materials.

New piping should be installed above ground to avoid major corrosion problems. Underground piping should be made of non-corroding material such as fiberglass reinforced plastic (FRP) or cathodically protected steel which provides a minimum of thirty (30) years of corrosion protection.

Metal ASTs should be painted to prevent exterior rusting of the shell. New ASTs should be protected by a primer coat, a bond coat, and two or more final coats of paint, or have an equivalent surface coating system. Most tanks are delivered with only a primer coat. The AST operator must make provisions for the rest of the coating system.

4.3 Containment Field

The containment field for ASTs generally consists of dikes and impoundments. These structures (secondary containment) were originally intended to control the spread of fire. Few early secondary containment structures had impermeable bottoms and could not protect groundwater from spillage within the containment field. Technology is currently available to design and construct containment fields and storm water diversion barriers for all ASTs and AST underground piping, including mobile or skid mounted tanks used at mining or construction sites. Double wall tanks serve as secondary containment so that a separate secondary containment basin is not required, but the piping and dispenser may require a separate containment structure or pan.

Secondary containment is used to protect the environment by catching and containing spills from the following:

- Overfill spills which usually discharge from tank vents
- Spills from fill ports and ruptured delivery hoses
- Leaks from pumps, valves and tank connections
- Discharges from valves which are accidentally left open
- Spills caused by sabotage or vandalism

4.3.1 Dikes

Dikes serve as traffic barriers, preventing vehicular damage to tanks, piping, pumps and valves. Variations on the traditional dike system are available to prevent leaks from reaching the environment. A system of impervious ditches, channels, or pipelines with a remote impoundment can be effective. The remote impoundment system also lowers the potential of a pool fire within the containment basin around the ASTs.

4.3.2 Liners

To satisfy the secondary containment requirement the tank dike or impoundment should have an impermeable barrier installed below the tank to prevent the release of spilled or leaked contaminants to soil and subsequently to groundwater. The barrier may be a concrete surface, a synthetic liner, a compacted clay liner or other impermeable material appropriate to contain the tank contents. Compacted clay barriers are not appropriate in karst* limestone and alluvial aquifers (e.g. Ohio River, Kanawha River and other alluvial plains) areas because of the high potential for rapid groundwater contamination by spilled materials which enter the soil.

* Karst topography is characterized by caves, sinkholes, disappearing streams and underground drainage. Karst forms when groundwater dissolves pockets of limestone, dolomite or gypsum in bedrock.

Earthen or compacted clay liners are prohibited in the following areas:

- Karst aquifer areas
- Aquifer areas as determined by the director to be vulnerable based on geologic or hydrogeologic information.
- Alluvial aquifers including, but not limited to the Ohio and Kanawha alluvial plains.

4.4 Specific Lining Applications

4.4.1 Potable Water Tanks

The United States Food and Drug Administration regulates the coatings that are acceptable for lining potable water tanks.

4.4.2 Diesel and Fuel Oil Tanks

Because these tanks are subject to sulfur-reducing bacteria and the related corrosion pitting that occurs, they are often coated with a thin film on the bottom and a few feet up the sides of the shell.

4.4.3 Motor Gas

Motor fuel tanks are often coated on the bottom only because of the water-phase-induced corrosion that generates pitting and product purity problems. However, many operators do not coat these tanks.

4.5 Storm Water

Storm water that collects within the secondary containment should be drained to a sump where it can be discharged using a siphon, pump or drain extended through the dike. Drains should be valved and kept locked in a closed position unless designed to drain directly to a wastewater treatment facility or a remote impoundment. Valves should be located outside the secondary containment area so they can be reached during a fire. It is important to keep the containment areas free of spilled material which might contaminate storm water. Contaminated storm water must be treated prior to discharge or disposed of properly. Appropriate analyses of storm water within a secondary containment must be conducted before discharge when the contaminants are water soluble and would not be visible. Contaminated water is prohibited from being discharged directly onto the ground by 47CSR58, Section 7.1. A West Virginia/National Pollutant Discharge Elimination System (WV/NPDES) permit is required for such discharges. A General Storm Water NPDES permit will not cover such discharges.

4.6 Leak Detection Methods

The most vulnerable component on a tank for a leak-type failure is the tank bottom. The tank bottom is subject to both internal and bottom side corrosion.

New ASTs should have some method of monitoring the space between the tank bottom and the impermeable barrier. Monitoring can be done by using sensors or by visually inspecting drain ways between the tank and the secondary containment. In addition, ASTs with underground piping should also have secondary containment, an automatic leak detection system, or both.

4.6.1 Release Prevention Barrier (RPB) System

This category of detection includes tanks with any liner including elastomers, double bottoms, or even properly designed concrete foundations which may function as a liner. The RPB concept is simply to lay an impermeable barrier between the tank bottom and the ground which directs leaks to the perimeter for visual recognition.

4.6.2 Volumetric & Mass

Volumetric leak detection is applicable to fixed-roof tanks and to floating-roof tanks. The basic idea of volumetric leak detection is that the temperature compensated volume in a tank should slowly be reduced by leakage occurring through the bottom. By shutting all flow into and out of a tank, its volume and liquid level should remain constant if the thermal expansion of the tank and the liquid is accounted for.

4.6.3 Acoustic Emissions

Acoustic emissions leak detection technology listens for the characteristic noises created by a leak from the bottom of the tank. The passive acoustic system operates essentially by detection and location of noise signals consistent with the types of signals emitted from the tank bottom.

It should be noted that the WVDEP does not favor one leak detection method over another. This guidance by no means covers all the methods and technologies available. The correct technique should be site specific to the application of the AST.

4.7 Gauges & High Level Alarms

Some method of determining the volume of material in an AST is necessary to prevent overfilling. The volume may be determined from a sight glass, a floating gauge, or a high-level warning alarm. Some high-level alarms trigger an automatic shutdown device to stop the flow of material to prevent a spill.

Alarms usually provide an audible (horn, bell, or whistle) or visual signal (light) when a tank is ninety (90) percent full. Shutdown devices are commonly designed to stop the product flow into the tank when it is ninety-five (95) percent full. The 5 to 10 percent of the tank volume is a safety and expansion factor. The tank owner should select the tank size based on the working capacity, not total capacity.
NOTE: Float vent valves which provide overfill prevention by slowing gravity deliveries to underground storage tanks are not appropriate for use with ASTs.

4.8 Valves

Tanks that have a pressure discharge through a remote pumping system should be equipped with a shear valve (impact valve) designed to close automatically if the dispenser is accidentally dislodged from the inlet pipe.

Gravity drained tanks should be equipped with both an operating valve to control the flow and a shutoff valve (such as a solenoid valve) to stop the flow if a piping or dispenser failure occurs.

Pump filled tanks should have fill pipes equipped with an operating valve and a check valve for protection against back flow.

4.9 Identification

ASTs should be identified with a tank number, design capacity, working capacity, and contents to help avoid overfill or product contamination. The label should be displayed at the gauge and on the tank.

SECTION 5.0

AST SAFETY CONSIDERATIONS

5.1 Vapor Recovery

Vapors from ASTs contribute to the formation of smog. Venting of these vapors should be controlled. Large tanks are usually equipped with floating roofs that minimize the space available for vapor formation. External floating roofs are used for open top tanks; internal floating roofs are used for fixed roof tanks.

Breathing vents, which might allow the escape of vapors, are controlled by pressure-vacuum devices or are equipped with atmospheric caps. This system relies on positive displacement and vacuum connection to the delivery truck to ensure vapor recovery.

To reduce splash and vapors, fill ports can be equipped with a submerged fill pipe and a diffuser extending to within six (6) inches of the tank bottom. A submerged fill pipe not only reduces the amount of vapor lost to the atmosphere but also the vapor returned to the delivery truck. Vapor losses can translate to substantial product loss and a loss of money for the tank owner.

5.2 Vents

The buildup of excessive tank pressure or vacuum may result whenever filling, emptying, or a temperature change occurs. Vents are used to minimize this buildup and protect the tank from any excessive pressure. An AST usually has two vents: an operating vent and an emergency vent. The operating vent allows air to enter and vapor to exit at a rate sufficient to prevent the tank from bursting or collapsing. The emergency vent provides the AST relief from pressure resulting from overfilling or overheating the tank contents if the tank is exposed to fire.

One type of emergency vent design is a loose bolt manhole. Operators frequently see these manholes open during a delivery and mistakenly tighten the bolts. During air testing of the tanks the normal long bolt is replaced with a short bolt and the manhole is bolted shut to allow testing. If the manhole is not reopened at the end of the test, then the emergency vent is effectively eliminated.

Eliminating the emergency vent results in a dangerous condition and should be corrected immediately. Without correction, the tank could fail if exposed to a fire or over-pressurized.

The latest editions of API Standard No. 2000, "Venting Atmospheric and Low- Pressure Storage Tanks: Nonrefrigerated and Refrigerated", the National Fire Protection Association (NFPA) Standard 30: "Flammable and Combustible Liquids Code", and NFPA 30A: "Code for

Motor Fuel Dispensing Facilities and Repair Garages" should be consulted for guidance on the sizing of AST vents.

5.3 Static Electricity

Static electricity generated during filling, draining or routine pumping operations around ASTs can cause a spark which ignites a tank's contents. This could generate a fire or explosion, and result in the discharge of the tank contents. Four rules will help prevent static sparks:

- **Metallic equipment and other electrical conductors must be grounded where flammable atmospheres can exist.**

When an ungrounded vacuum truck is removing tank bottoms, the flow of flammable liquid can cause a significant static charge to develop on the truck and hose. The charge can then arc to the tank causing an explosion. The truck should use a grounding strap connected to an appropriate grounded object to prevent an accident.

Any hose that has a metal coupling or stiffener should be grounded and double checked. **DO NOT** assume the hose is grounded through the spiral metal stiffener. These wires are often broken internally or are not connected to the couplings. This ungrounded conductor is a dangerous source of sparks from static electricity.

- **Do not open, sample, gauge, disturb, or insert anything into a tank while it is being filled or emptied.**

Liquids or vapors flowing through pipes may generate static electricity by a phenomenon known as streaming currents. The greater the velocity of flow, the greater the potential for static charge build up. Streaming currents are not the only source of static charges. Air bubbles or water droplets in a liquid, a mist, bubbling compressed gasses through liquids, and agitation can also create static electricity. A common tank cleaning operation that involves applying steam through nozzles is notorious for generating static charges.

Another common source of static buildup is splash filling, which causes turbulence and droplet formation. Splash filling is defined as dropping liquid from the top of a tank through an open pipe at a velocity greater than one meter per second. The energy of pumping, flowing or agitating liquids may create static charges regardless of whether or not the fluid is conductive.

- **Minimize the delivery rate to reduce static buildup.**

Filling tanks, trucks, or other containers at a low flow rate reduces the possibility of generating sufficient static charge to be an ignition source. The rule for filling is that the velocity of the liquid should not exceed one meter per second unless the fill line is submerged. {A flow rate of one meter per second is equivalent to 32 gallons per minute (GPM) through a two inch diameter nozzle, or 72 GPM through a three inch diameter nozzle, or 128 GPM through a four inch diameter nozzle.}

Tanks without submerged fill pipes have ignited when being filled at high velocity. Even when the fill line is submerged, static discharges may occur if velocities are extremely high and items which increase static electricity, such as filters, are used.

- **Wait at least thirty (30) minutes after filling a tank before opening, sampling, or inserting an object into it.**

After filling stops and the generation of any static charge has ceased, time is still required for the charge to bleed away to ground. This time period can be especially significant when filling a tank with a non-conductive liquid. Common practice is that thirty (30) minutes is sufficient for most cases and is the rule specified in NFPA and API documents.

5.3.1 Plastic tanks

These generally accepted rules may not apply to plastic tanks holding more than one thousand (1,000) gallons. These tanks have an unusually high resistance path to ground. Many plastic tanks also have flammable atmospheres and may be explosive. As a result, the typical thirty (30) minute waiting time for the charge to bleed away from the tank may be insufficient to ensure that the potential for a spark to generate has been eliminated. If a metal object is brought near a tank with a static charge and a flammable atmosphere, a spark could occur. Using a grounded metallic dip tube or grounding wire could decrease the risk of a spark. If the metal part was not grounded properly, the chance of a static spark is increased.

Follow these safety precautions to minimize the possibility of a spark in a plastic tank:

- Apply the one meter per second rule for filling rates until the filling nozzle is submerged.
- Wait at least five hours, preferably overnight, before opening the tank, gauging it, or introducing an ungrounded conductor to or near the tank.
- Ensure that all metal appurtenances, flanges, couplings, etc. are bonded and grounded.

Many static electricity discharges have not resulted in serious accidents only because the spark occurred in an atmosphere too rich for an explosion. Relying solely on the possibility that the material being handled is not within the flammable limits will not ensure your personal safety or the safety of your personnel. Be on the alert for situations where static buildup can occur and always apply the rules discussed above.

5.4 Underground Storage Tanks (USTs)

Underground storage tanks must not be used above ground without the advice of a structural engineer or the tank manufacturer. USTs gain structural support from the surrounding backfill or soil and are designed to a lower standard than above ground tanks which must support the weight of the stored product. A two thousand (2,000) gallon tank filled with gasoline weighs more than seven tons. In addition, tanks designed for underground use do not have emergency vents as required for ASTs.

SECTION 6.0

AST CLOSURE

6.1 Guidance

This section is a general guidance toward the safe and environmentally sound closure of above ground storage tanks. Check with the offices listed for more details or answers for site-specific questions. The following steps should be followed for the proper closure of ASTs in West Virginia:

- Site Inspection
  - Ensure adequate access to tanks.
  - Verify site clearances.
  - Confirm that product or tank contents have been removed.
  - Clear work area of debris and equipment.

- Identify Hazards
  - Hazardous Materials Requirements – if explosive, combustible, toxic, radioactive or reactive tank contents are present call DEP – Division of Water and Waste Management **Marjorie Skeens (304-926-0499, ext. 1297)** or email **Marjorie.A.Skeens@wv.gov**.
  - Check for Benzene or Lead in tank scale.
  - Demolition and traffic hazards.

- Write a Site Safety Plan – keep copy on site for inspectors.

- Notify Agencies
  - State Fire Marshall–Inspection Division-(**304-558-2191**)
  - DEP – Office of Environmental Enforcement–(**304-926-0470**)
  - Any local fire authority.

- Secure Permits
  - Construction/Demolition
  - Waste Disposal – tank and tank contents.

- Prepare Site
  - Ensure safety by removing ignition sources and grounding all metal objects.
  - Secure site – control access by public.

- Prepare Piping – Drain all piping to tank.

- Empty Tank – Contents must be pumped by licensed waste hauler, may be reused, recycled, or disposed of properly.

- De-gas Tank Atmosphere
    - Purge with air.
    - Displace vapors with heavy inert gas.
    - Monitor tank atmosphere for Lower Explosive Limit (LEL)

- Clean tank and dispose of tank cleaning residue properly – continue to monitor tank atmosphere.

- Prepare tank for transport – Use API procedures including warning sign on tank.

- Obtain written certification by contractor and waste hauler material disposal documentation.

- Soil Assessment – Sample soil where identified by staining, soil screening device, or DEP inspector. See Groundwater and Soil Limits table in **Appendix A.**

- Report soil sampling results to inspector and appropriate DEP office.

- Additional soil and groundwater monitoring and cleanup as required.

6.2 Post Fuel Storage

Above Ground Storage Tanks that have been properly decontaminated may be used for other purposes such as water storage. Analytical sampling should be conducted and the analyses submitted to verify decontamination prior to post fuel storage use.

- Sampling of rinse water for TPH – DRO should be submitted prior to the use of ASTs which have contained diesel fuel or other low volatility petroleum products.

- Sampling of rinse water for TPH – GRO and Lead should be submitted prior to the use of ASTs which have contained gasoline.

Submit all decontamination verification analyses to:

WVDEP – Division of Water and Waste Management
Groundwater Program
601 57th St.
Charleston, WV 25304
304-926-0499, ext. 1052

APPENDIX A

Groundwater & Soil Limits

GROUNDWATER AND SOIL LIMITS

Parameter	*Groundwater*		*Soil*	
TPH-GRO	1.0 mg/L	DEP Action Level	100 mg/kg	DEP Action Level
TPH-DRO	1.0 mg/L	DEP Action Level	100 mg/kg	DEP Action Level
TPH-ORO	1.0 mg/L	DEP Action Level	100 mg/kg	DEP Action Level
Benzene	0.005 mg/L	47-CSR-12	50 ug/kg	DEP Action Level
Ethylbenzene	0.7 mg/L	47-CSR-12		
Toluene	1.0 mg/L	47-CSR-12		
Total Xylenes	10.0 mg/L	47-CSR-12		
Total BTEX			10 mg/kg	DEP Action Level
Total PAHs			1 mg/kg	DEP Action Level
MTBE	20 µg/L	DEP Action Level		
Napthalene	20 µg/L	Health-Based Limit		
Dissolved Lead	0.015 mg/L	47-CSR-12		

Those limits set by Title 47, Series 12, The Requirements Governing Groundwater Standards, are set by the West Virginia legislature and, as such cannot be deviated from. However, those limits that are DEP Action Levels are guideline concentrations used by our office and the Office of Environmental Remediation, and these may be adjusted site by site, as needed.